REMEDIAL INSTRUCTION TO ENHANCE MATHEMATICAL ABILITY OF DYSCALCULICS

By

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ABSTRACT

The ability to do arithmetic calculations is essential to school-based learning and skill development in an information rich society. Arithmetic is a basic academic skill that is needed for learning which includes the skills such as counting, calculating, reasoning etc. that are used for performing mathematical calculations. Unfortunately, many students in today's schools do not perform well in mathematics. It is found that most of the children lack the ability to acquire arithmetic skills despite having average or even above average level of intelligence. Dyscalculia is the learning disorder in which pupils face severe difficulties in performing mathematical computations. It is essential for schoolchildren need to develop the mathematical abilities through the use of different learning strategies or techniques.

The use of instructional media is an essential component of teaching-learning process which contributes to the efficiency as well as effectiveness of the teaching-learning process. Remedial instruction has a very important role to play as a differentiated instruction which employs different instructional techniques through the use of different instructional materials. The use of such techniques and materials in the classroom encourages active learning and meets the diverse needs of the learners. Certain research studies (Ota, 2008; Moomaw and Coup, 2008; Michaelson and Thomas, 2007; Lugo, 2005; Mohankumar & Rajaguru, 2001; Mishra, 1991; Nwaizu & Ifeanyi, 1991) reveal that the vast majority of problems experienced by mathematically disabled learners can be through appropriate, explicit and early instruction and intervention.

The present investigation examined the effectiveness of remedial instruction in enhancing mathematical ability of dyscalculic children. The single group design was followed for conducting the study. The sample comprised of 46 dyscalculic students at the primary level. The tool used was a Mathematical Ability Test prepared by the investigators. 't' test for dependent groups was employed for the analysis of data. The results of the study indicated that remedial instruction enhanced the mathematical ability of dyscalculic children.

Keywords: Arithmetic, Dyscalculia, Remedial Instruction.

INTRODUCTION

School children have diverse learning abilities and their academic performances vary from one another. The ability to do read, write or do arithmetic calculations is very much essential to school-based learning. Unlike reading and writing, arithmetic is a basic academic skill that is needed for learning which includes the skills such as counting, calculating, reasoning etc. These skills are used for performing mathematical calculations. Unfortunately, many students in today's schools do not perform well in mathematics. It is essential for schoolchildren need to develop the mathematical abilities through the use of different learning strategies or techniques.

There are various learning disorders that interfere with the development of the basic skills needed for learning. Dyscalculia is the learning disorder in which pupils face severe difficulties in performing mathematical computations. Children with learning disabilities like dyscalculia are found in most schools. It is essential for teachers to understand the special needs of such children. The adoption and use of different techniques and materials in the classroom encourages active

learning and meets the diverse needs of these learners.

Remedial instruction can help in the learning of such pupils with arithmetic disabilities. It has a very important role to play as a differentiated instruction which employs different instructional techniques through the use of different instructional materials. In addition, these disabled students need a great deal of structured practice and immediate corrective feedback to develop their numerical skills. Repeated reinforcement and specific practice of mathematical ideas can make understanding easier. Many students need individual attention to fully grasp certain concepts and it is the duty of teachers to provide individual care and attention to them to help them cope up with their learning through remedial programmes.

Mathematical Ability

It is commonly believed among teachers and educationists that mathematical ability is an inheritable special ability. Mathematical abilities include using mathematical symbols confidently, intuitive grasp of mathematical patterns and relationships, generalizing from the study of examples, remembering generalized mathematical relationships, rapid grasp of new material, rapid grasp of direction of a problem, manipulating algebraic expressions, ability to reverse mathematical processes, developing a clear mental picture of a problem, ability to view a problem from different angles, logical reasoning, thinking flexibly and so on (Kennard, 2001: 2-7). It is essential to develop these abilities among the schoolchildren for their academic achievement.

Generally pupils find mathematics as a difficult subject and develop a negative attitude towards the subject. Recent investigations in this field have shown a person of normal intelligence can easily cope with this subject. Mathematical ability has nothing to do with general intelligence and it requires no talent at all (Geetha, 2008: 8). Even then the accomplishment in mathematics is generally poor and pupils find it as a difficult subject. As a result the pupils may develop a phobia towards the subject.

Building a solid foundation in mathematics requires different skills. Mathematics is a subject which requires various skills such as perceptual reasoning, verbal reasoning, counting and calculating. If basic mathematical skills are not mastered, schoolchildren may find it difficult in moving on to more advanced mathematical applications. The poor quality of learning at elementary stages gives children a weak foundation and it directly affects their learning at the high school stage and even carries over further. Many children are found to be mathematically handicapped rather than being slow learners. Learning achievement surveys taken by the National Council of Education, Research and Training (NCERT) recently shows that mathematics teaching calls for more attention to help children acquire the basic skills of mathematics (The New Indian Express, 2008: 6). So the task of teaching mathematics to students is a challenging one.

Dyscalculia

Learning disability is a real problem in today's society. A learning disability is nothing but difficulty in learning which hampers the ability to perform well in academics. Learning-disabled students often find it difficult to acquire the basic skills which may pervade their performance in curricular and co-curricular activities. These children suffer from severe learning problems in the same way as experienced by mentally handicapped children or physically handicapped children in terms of their mental abilities or physical abilities respectively (Kumar & Raja, 2009: 9).

A disability in learning mathematics is found across all ages and in all socio-economic classes. Children with learning disabilities experience even greater difficulty in mathematics than their peers with normal abilities. Dyscalculia is a learning disorder in which pupils face severe difficulties in performing mathematical computations. The term dyscalculia is the most widely used term for the learning problems and difficulties in mathematics faced by the learning-disabled children (Mangal, 2007: 249). Dyscalculia or arithmetic disorder is a less widely known disability, similar and potentially related to other learning disabilities like dyslexia, dysgraphia, dysphasia or dyspraxia and is often not

identified. Learning disabilities like dyscalculia are either not understood or ignored in schools (Raja & Kumar, 2011: 50).

Dyscalculic learners who are weak in mathematics cannot be considered as less intelligent. Dyscalculic children may have average or above average intelligence and also they may be slow learners, average learners or even gifted children. These children are at-risk for being seen as less capable than they are. However they have the general ability to learn that is comparable to or higher than many of their peers (http://www.learning disabilities.about.com). Dyscalculia can be found in a person of any IQ, from low through high. It occurs in pupils across the whole IQ range and the sufferers often have difficulties with time, measurement or spatial reasoning. In most cases, the IQ level of dyscalculic learners is found to be normal. An individual could be low functioning in mathematics and yet have above normal intelligence (Nakra, 1996: 160).

Mathematical disabilities comprise computational problems in addition, subtraction, multiplication or division and failure in application of mathematical rules and conceptual problems such as poor understanding, difficulty in discriminating relevant and irrelevant aspects of problems of mathematics, poor number sense, poor discrimination between shapes, sizes and quantities, poor spatial orientation etc. Dyscalculics have disturbances related to reading and writing numerals and symbols, and also disturbances in visual-motor integration, either for writing or for non-verbal motor skills (Chadha, 2006). Arithmetic involves recognizing numbers and symbols, memorizing facts, aligning numbers and understanding abstract concepts like place value and fractions. Any of these may be difficult for children with dyscalculia. Problems with numbers or basic facts are likely to occur in the early school grades while the problems with reasoning are found in the later grades (http:www.ldonline.org/ article/Learning_Disabilities%3A).

Many school children with mathematical learning disabilities may have difficulty in solving basic mathematical problems, if not diagnosed at the early stages of learning. They may find it difficult to remember even basic mathematical facts and may struggle to apply their knowledge and skills to solve mathematical problems. If the basic mathematical skills are not mastered, many teenagers and adults with dyscalculia may have difficulty in doing more advanced mathematical calculations (Kumar & Raja, 2008: 89).

Remedial Instructionfor Dyscalculics

When students struggle with academic concepts, schools try a variety of intervention tactics. Remediation strategies are one type of intervention. Effective remediation involves assessing the student's needs, providing intervention and evaluating student outcomes. Successful remediation programs adjust the instruction based on the student's response to the intervention (http://www.ehow.com/info_8065079_remediation-activities.html). Thus, remedial instruction refers to the instruction by the teacher with the support of different instructional techniques through the use of different instructional materials. It can help to improve the academic abilities of learning-disabled pupils. The extent to which pupils show improvement in their academic skills depends on how well-structured and well organized the remedial programme is.

Research indicates that the brains of persons with learning disabilities are wired differently and hence they have to be taught differently. Traditional teaching methods do not seem to work with them. If they cannot learn because of the way they are taught, they have to be taught in the way that they learn. Teachers have to be willing to match their teaching style to the learning style of the student. There are visual, auditory and kinesthetic learners and teachers should teach to the modality of the students. Individuals with learning disabilities should be presented with bite-size information and material should be presented in sequential steps (Saravanbhavan, 2009).

Certain research studies reveal that the vast majority of problems experienced by mathematically disabled learners can be through appropriate, explicit and early instruction and intervention. Ota (2008) in his study which determined the responsiveness of the elementary-aged students with and without specific learning disabilities to

interventions for mathematics calculation revealed that empirically-derived interventions were effective in enhancing the calculation skills of students with and without specific learning disabilities and maintaining their skills during and after the intervention phase and that the students demonstrated high levels of satisfaction with the interventions and enhanced their self-efficacy across the study.

A study (Moomaw & Coup, 2008) revealed that mathematics-based curriculum measure that can be used to assess the ongoing development of quantitative reasoning in children is a valid and reliable measure of number sense. Another study regarding methods for ascertaining and accommodating dyscalculic children in the classroom conducted by Michaelson and Thomas (2007) suggests that certain practical methods and instructional designs can be implemented in the classroom to address the specific learning needs of dyscalculic learners which help them to learn mathematics in a meaningful and enjoyable way through activities.

Mohankumar and Rajaguru (2001) on evaluating the effect of using multimedia instructional strategy for children with learning disabilities found that multimedia instruction facilitated such students in learning algebra concepts rather than their counterparts in conventional teaching group. On exploring the effects of multimedia-based instructional technology on the problem-solving in Algebra skills of ninth through twelfth grade students with learning disabilities it is shown that multimedia computer technology could be a potential supplementary teaching aid that teachers use in addition to traditional classroom instruction (Lugo, 2005).

The study which centred upon the problem of development of teaching steps for handling children with arithmetic disorders through developing scientific steps in teaching addition and subtraction revealed that with training and following the teaching steps, the subjects with disabilities could perform in a better way and retain in the memory what they learned for a long period (Mishra, 1991). Nwaizu & Ifeanyi (1991) in their study found that students had higher retention level of multiplication facts mastered during computer-assisted instruction (CAI) than during teacher-assisted instruction.

Remedial instruction for this study included different features such as blackboard work, group work and activities through visual explanations and hands-on experiences. This type of instruction can be valuable in presenting educational tasks to dyscalculics to improve their mathematical skills. It can cater to the individual differences among pupils by allowing them to learn mathematics in accordance with their learning style.

Significance of the Study

A learning disability like Dyscalculia cuts across class, age and intelligence. Most schools may have some dyscalculic children. If any subject area of study presents problematic situations for sensitive learners in this category and evokes wide critical or satirical comments in school or at home, it is Mathematics. It has become quite the social norm for most pupils to say that Mathematics is a hard subject. Learning-disabled pupils, where Mathematics is concerned are children with special needs. Most schools may have some dyscalculic children.

The study is of relevance to teachers in different educational environments dealing with children facing difficulties in mathematics. This study is highly beneficial in as it seeks to ensure the efficient teaching methods for dyscalculics to assimilate mathematical concepts through remedial instruction. An awareness that there are certain teaching methods and practical approaches which are effective with such children is essential for class teachers particularly of primary schools. Also the investigator being a student of mathematics felt the need for adopting a new instruction which would enable the mathematically disabled students to enhance their mathematical ability. Moreover, it would bring awareness to parents and teachers regarding different types of learning disorders in mathematics found among the children and the ways and means to overcome them. Therefore a study on remedial instruction on the performance of dyscalculic students at the primary level is being attempted.

Objectives

The study has the following objectives

- To find out whether there is any significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction.
- To find out whether there is any significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Age.
- To find out whether there is any significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Gender.
- To find out whether there is any significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Locality.

Hypotheses

In the light of the above objectives, the following hypotheses were set up for the present study.

- There will be significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction.
- There will be significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Age.
- There will be significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Gender.
- There will be significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Locality.

Methodology

The single group experimental design was used for the present study. 46 dyscalculic students studying in Standard V were selected as the treatment group.

Sample

The investigators have selected the standard V students from two matriculation schools of Kanyakumari district in Tamil Nadu, India to serve as the treatment group. There were 46 Standard V students who were identified as dyscalculics by conducting the mathematical ability test prepared by the investigators for screening those children.

Tool used

The investigators have constructed and validated the mathematical ability test consisting of 60 objective type questions. The questions in the tool were used to test 15 different categories of mathematical abilities of students such as counting ability, identification of correct symbol, identification of smallest or greatest number, identification of correct sign, concept of time, concept of size, spatial ability, concept of fraction, identification of correct shape, computation ability, concept of place value, ability to use mathematical language, sequential ability, reasoning ability, and perceptual ability. The mathematical ability test used for screening showed that the sample students were weak in the areas such as visual-spatial problems, difficulty in identification of signs and symbols, difficulty in discrimination of shapes, difficulty with the concept of place value and fractions, difficulty in performing the basic fundamental operations of addition, subtraction, multiplication, division etc.

Treatment

The students of treatment group were given remedial instruction to improve their mathematical ability. Remedial instruction for this study included different features such as blackboard work, group work and activities through visual explanations and hands-on experiences. This type of instruction can be valuable in presenting educational tasks to dyscalculics to acquaint them with the mathematical skills. The treatment lasted for a period of one week (7 days x 45 minutes).

Data Analysis

For the verification of the hypotheses, suitable statistical methods have been adopted. The statistical techniques employed for the analysis of data were mean, standard deviation and 't' test for dependent groups.

The analysed data are presented in the Tables 1 to 4 with

the apposite interpretations.

Since p value is lesser than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between the scores of the treatment group before and after remedial instruction. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction.

Since p value is lesser than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between the scores of the treatment group before and after remedial instruction with regard to age. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to age.

Since p value is lesser than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between the scores of the treatment group before and after remedial instruction with regard to gender. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to gender.

Since p value is lesser than 0.01, the null hypothesis is rejected at 1% level of significance. Hence it is concluded that there is significant difference between the scores of the treatment group before and after remedial instruction with regard to locality. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to locality.

Group	Size	Mean	Std. Deviation	t value	p value
Before remedial instruction	46	30.83	4.562	16.241	0.000*
After remedial instruction	46	48.07	6.108		

Table 1. Difference between the mathematical ability test scores of the treatment group before and after remedial instruction

Age of students	Group	Size	Mean	Std. Deviation	t value	p value
10 years and below	Before remedial instruction	9	35.00	2.398	6.581	0.000*
	After remedial instruction	9	49.56	6.876		
Above 10 years	Before remedial instruction	37	29.81	4.396	14.982	0.000*
	After remedial instruction	37	47.70	5.953		

Table 2. Difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Age

Findings

- There is significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction.
- There is significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Age. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to Age.
- There is significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Gender. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to Gender.

Gender of students	Group	Size	Mean	Std. Deviation	t value	p value
Male	Before remedial instruction	31	29.77	4.951	13.21	0.000*
	After remedial instruction	31	47.71	5.984		
Female	Before remedial instruction	15	33.00	2.619	9.570	0.000*
	After remedial instruction	15	48.80	6.505		

Table 3. Difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Gender

Locality of students	Group	Size	Mean	Std. Deviation	t value	p value
Rural	Before remedial instruction	26	29.54	5.501	11.922	0.000*
	After remedial instruction	26	47.23	5.729		
Urban	Before remedial instruction	20	32.25	1.618	10.794	0.000*
	After remedial instruction	20	48.85	6.651		

Table 4. Difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Locality

• There is significant difference between the mathematical ability test scores of the treatment group before and after remedial instruction with regard to Locality. The mean scores show that the students of treatment group scored better after remedial instruction than before remedial instruction with regard to Locality.

Educational Implications

The findings of the study contribute to day-to-day classroom teaching. The results indicate that remedial instruction helps in enhancing the mathematical ability of dyscalculic learners. Remedial instruction fosters better understanding and could be delivered in the schools for the benefit of students who are academically weak learners.

There is a great challenge on the part of teachers to deal with those children with arithmetic disorders by using innovative teaching strategies. It is necessary that teachers understand the psychology of each and every child and identify the challenges faced by the children in learning mathematics. Early identification and prevention are needed through intervention strategies for any category of dyscalculic problems of the schoolchildren. Remedial instruction as a strategy could be adopted by all teachers for the benefit of all learners who face severe problems in learning mathematics. It can be certain that those with learning difficulties in mathematics could enhance their performance in academics at least to some extent through remedial instruction. The use of activities in the classroom fosters better understanding, organization and imagination of mathematical concepts.

The adoption of remedial instruction could create a wide range of learning opportunities for such educationally backward learners. Students can benefit from visual representations of pictures, diagrams etc and kinesthetic experiences such as working with real objects and models. Using such instructional methods, dyscalculics made to develop their arithmetic skills. Thus remedial instruction caters to the needs of diverse learners by adopting different ways of presenting the information in the classroom.

Conclusion

Remedial instruction is thus found to be an effective strategy in enhancing the performance of dyscalculic children. It is necessary for teachers to get rid of traditional method of teaching and use different kinds of instruction in the classroom which provides variety and interest in learning. With proper instruction provided by the teachers, dyscalculics can be made to do arithmetic calculations in correct ways. In addition, these disabled students need a great deal of structured practice to develop their mathematical skills. It is essential that teachers adopt the right kind of instruction to cater to the individual differences in the classroom which can overcome dyscalculic problems and help students attain tangible improvement in mathematical abilities.

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